CLAIMS

1.   A method of converting a data stream received in a specified Transport Stream (TS) format into an output data stream in a specified Program Stream (PS) format, the TS format being one in which at least first and second packetised elementary streams of encoded information relating to a desired programme have been further packetised into TS packets and multiplexed together with further streams relating to different programmes, the PS format being one in which the first and second elementary stream and optionally others relating generally to a selected programme are packetised and their packets interleaved to form a multiplexed stream of PS packs, each PS pack including a pack header and one or more whole packets of the packetised elementary streams, wherein said method comprises:

(a) extracting from the received data stream program mapping information identifying a current stream index for each of the first and second elementary streams;

(b) filtering data of the received data stream to extract packets carrying the desired elementary streams;

(c) parsing the first and second elementary streams in accordance with packet header information to identify a sequence of presentation units within the payload of each desired elementary stream;

(d) writing the presentation units of each stream in sequence into first and second payload queues respectively prior to re-multiplexing;

(e) determining, in accordance with a synchronous relationship between the elementary streams and with a PS target decoder model and PS stream constraints, a valid PS schedule for re-multiplexing payload data from the first and second payload queues into a series of PS packs; and

(f) in accordance with the determined PS schedule, retrieving said payload data from each queue, inserting packet headers so as to re-packetise each elementary stream, generating PS pack headers and multiplexing the packets of the first and second elementary streams into a series of PS packs so as to generate said output signal;

wherein the PS schedule determined in step (e) is dependent on the scheduling of presentation units within the received TS format signal.

2.   A method as claimed in claim 1 further comprising:

(g)   extracting from the received data stream timing references associated with specific points in the packetised elementary streams and calculating a time stamp value for each presentation unit in each elementary stream, including interpolated time stamp values for those presentation units not accompanied by a timing reference in the received TS format data stream;

(h)   writing the time stamp values into first and second time stamp queues so as to correspond with the respective presentation units entered in the first and second payload queues; and

(i)   retrieving each time stamp value from the queue when retrieving the corresponding payload data.

3.   A method as claimed in claim 1 wherein a presentation timing reference value is included in the PS pack for any new presentation unit starting within the pack, said presentation timing being obtained by calculation from TS delivery timing and presentation timing reference fields accompanying certain presentation units within the received data stream, and by interpolation for presentation units not accompanied by a delivery timing reference in the received TS format data stream.

4.   A method as claimed in claim 3 wherein the data rate of the first elementary stream is substantially greater than that of the second elementary stream,

5.   A method as claimed in claim 3 wherein in step (e) payload data from plural TS packets of the first elementary stream is generally accumulated to fill substantially a complete PS pack before scheduling any of said data in the PS schedule.

6. A method as claimed in claim 5 wherein in step (e) payload data corresponding to one complete presentation unit of the second elementary stream will be scheduled without waiting for data of the elementary stream to fill substantially a complete PS pack.

7. A method as claimed in claim 6 wherein in step (e) the data of the first elementary stream is delayed in the first payload queue by a delay at least equal to a minimum time required to receive one complete presentation unit of the second elementary stream, while a presentation unit of the second elementary stream may be scheduled immediately it is completely received.

8. A method as claimed in claim 7 wherein the different presentation unit data sizes and/or different data delivery rates are valid within the TS format for the second elementary stream, and wherein said minimum time is fixed at least equal to the time required to receive one complete presentation unit of the largest size at the lowest rate.

9. A method as claimed in claim 1 wherein the PS format specifies a minimum buffer size for holding the first elementary stream payload in a compatible decoder during decoding, and wherein the first payload queue has a maximum capacity less than one tenth said minimum buffer size.

10. A method as claimed in claim 1 wherein the PS format specifies a minimum buffer size for holding the first elementary stream payload in a compatible decoder during decoding, and wherein the first payload queue has a maximum capacity less than one twentieth said minimum buffer size.

11. A method as claimed in claim 1 wherein the first payload queue has a maximum capacity between one and a half (1.5) and four (4) times the size of each PS pack.

12.   A method as claimed in claim 1 wherein each entry in the time stamp queue records for the corresponding presentation unit a TS format delivery time of the presentation unit within the received data stream and a presentation time for the presentation unit after decoding, and wherein the PS

5   pack containing the same presentation unit includes an indication of a PS format delivery time for the pack and an indication of presentation time for at least one presentation unit within the PS pack.

13.   A method as claimed in claim 1 wherein timing reference values

10   included in the PS format output data stream are calculated with reference to a single time base irrespective of changes in time base throughout the received TS format data stream.

14.   A method as claimed in claim 1 wherein said PS packs and

15   elementary stream packets are generated so as to align the start of a new presentation unit preferentially with the start of a PS pack irrespective of misalignment between corresponding features in the received TS format data stream.

20   15.   A method as claimed in claim 1 wherein said PS format data stream is generated so as to employ a fixed program mapping irrespective of changes in program mapping signalled and followed in the TS format stream.

16.   A method as claimed in claim 1 wherein the presentation units of

25   the first elementary stream comprises encoded video pictures and the presentation units of the second elementary stream comprises encoded audio frames.

17.   A method as claimed in claim 1 wherein said TS format is

30   compliant with the MPEG-2 Transport Stream specification, while said PS format is compliant with the MPEG-2 Program Stream specification, both as defined in ITU-T Recommendation H.222.0 and ISO/IEC 13818-1.

18.   A method of recording an audio-visual programme wherein a programme to be recorded is selected from among a plurality of programmes conveyed in a transport stream (TS) format, converted to a program stream (PS) format by a method as claimed in claim 1, and then recorded on a recording medium for subsequent retrieval and decoding.

19.   An apparatus comprising means for receiving an input data stream in a first format wherein at least two elementary streams of data are multiplexed and means for converting the data to a second format to generate an output stream, said converting means comprising means specifically adapted to implement a method as claimed in claim 1.

20.   An apparatus as claimed in claim 19, the apparatus comprising one of: a stand-alone decoder apparatus for digital video programmes, a presentation apparatus having a display for video programmes, and a reproducing apparatus for playing and optionally also for recording digital video programmes.